SmartSwitch 9000
9H423-26
User's Guide

9032242-02

CABLETRON SYSTEMS

The Complete Networking Solution™

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DECLARATION OF CONFORMITY ADDENDUM

Application of Council Directive(s):	**89/336/EEC** **73/23/EEC**
Manufacturer's Name:	**Cabletron Systems, Inc.**
Manufacturer's Address:	**35 Industrial Way** **PO Box 5005** **Rochester, NH 03867**
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European Representative Address:	**Cabletron Systems Limited** **Nexus House, Newbury Business Park** **London Road, Newbury** **Berkshire RG13 2PZ, England**
Conformance to Directive(s)/Product Standards:	**EC Directive 89/336/EEC** **EC Directive 73/23/EEC** **EN 55022** **EN 50082-1** **EN 60950**
Equipment Type/Environment:	**Networking Equipment, for use in a** Commercial or Light **Industrial Environment.**

We the undersigned, hereby declare, under our sole responsibility, that the equipment packaged with this notice conforms to the above directives.

Manufacturer	Legal Representative in Europe
Mr. Ronald Fotino	Mr. J. Solari
Full Name	Full Name
Principal Compliance Engineer	Managing Director - E.M.E.A.
Title	Title
Rochester, NH, USA	Newbury, Berkshire, England
Location	Location

Safety Information

CLASS 1 LASER TRANSCEIVERS

The 9H423-26 is a Class 1 Laser Product

The 9H423-26 uses a Class 1 Laser transceiver. Read the following safety information before installing or operating these adapters.

The Class 1 laser transceivers use an optical feedback loop to maintain Class 1 operation limits. This control loop eliminates the need for maintenance checks or adjustments. The output is factory set, and does not allow any user adjustment. Class 1 Laser transceivers comply with the following safety standards:

- 21 CFR 1040.10 and 1040.11 U.S. Department of Health and Human Services (FDA).
- IEC Publication 825 (International Electrotechnical Commission).
- CENELEC EN 60825 (European Committee for Electrotechnical Standardization).

When operating within their performance limitations, laser transceiver output meets the Class 1 accessible emission limit of all three standards. Class 1 levels of laser radiation are not considered hazardous.

Laser Radiation and Connectors

When the connector is in place, all laser radiation remains within the fiber. The maximum amount of radiant power exiting the fiber (under normal conditions) is -12.6 dBm or 55×10^{-6} watts.

Removing the optical connector from the transceiver allows laser radiation to emit directly from the optical port. The maximum radiance from the optical port (under worst case conditions) is 0.8 W cm^{-2} or 8×10^{3} W m^{2} sr-1.

Do not use optical instruments to view the laser output. The use of optical instruments to view laser output increases eye hazard. When viewing the output optical port, power must be removed from the network adapter.

Contents

Chapter 1 Introduction

Features 1-2
Related Manuals 1-6
Getting Help 1-6

Chapter 2 Installing the 9H423-26 Module

Unpacking the Module 2-1
User-Accessible Components 2-1
Setting the Module DIP Switch 2-2
Installing the Module in the SmartSwitch 9000 Chassis 2-4
The Reset Switch 2-6

Chapter 3 Operation

FENIB 3-2
SmartSwitch ASIC 3-3
    Traditional Switch 3-3
VLAN 3-3
    VLAN Domains 3-4
    Fully Meshed VLAN Domains 3-5
SecureFast VLAN Switches 3-5
i960 Core 3-6
INB NIB 3-6
System Management Buses 3-6
    SMB-1 Bus 3-6
    SMB-10 Bus 3-7
System Diagnostic Controller 3-7
DC / DC Converter 3-7
INB Interface 3-7
        ITDM Arbitration levels 3-8
        Monarch / Slave SmartSwitch 9000 Modules 3-9

Chapter 4 LANVIEW LEDs

Chapter 5 Specifications

Technical Specifications 5-1
CPU 5-1
Memory 5-1
Standards 5-1
Network Interfaces 5-1
Safety 5-2
Service 5-2
Physical 5-2
Dimensions 5-2
Weight 5-2
Environment 5-3

Appendix A 9H423-26 Cabling Requirements

Overview A-1
Fast Ethernet Standard Requirements A-2
100BASE-TX A-2
100BASE-FX A-7
Why is CAT 5 Cable Necessary for 100BASE-TX? A-7
Why are CAT 5 Connectors Necessary for 100BASE-TX? A-11
Fiber Optic Cabling A-13

Chapter 1

Introduction

The 9H423-26 (Figure 1-1) is a switching module with twenty-six 100 Mbps Ethernet ports. The module is configured with two RJ21 connectors (Category 5 rated), providing twenty-four ports, and two multimode fiber SC connectors. Each module also provides an additional port that connects directly to the Internal Network Bus (INB) backplane interface. This module uses a SmartSwitch ASIC design and an advanced Intel i960® microprocessor. This microprocessor provides a platform for all management functions within a scalable RISC-Based Architecture.

This module can operate in two modes: either as a 26-port Ethernet traditional switch (using 802.1d standards) with a high speed backbone connection, or as a SecureFast switch (SFS) with 26 Ethernet connections. Each port can be configured to operate in the full duplex mode. This configuration allows each 100BASE-T port to provide a full 200 Mbps. The 100BASE-T ports can operate in either half or full duplex mode. The fiber ports operate only in full duplex mode and operate only at 100 Mbps.

The 9H423-26 module is specifically designed for use in the wiring closet. A typical configuration would have clients connected to the module (via the RJ21 connectors) and servers located in data centers connected via the 100 Mbps fiber uplink.

Network management information is available through a variety of methods. All information based on Simple Network Management Protocol (SNMP) is accessible either via an in-band (Front Panel port), Side Band (SMB-10), or via the Environmental Module's COM ports. Serial Line Internet Protocol (SLIP) or Point-to-Point Protocol (PPP) is supported by the Environmental Module's COM ports. For more information on the SMB-10, SLIP or PPP refer to the *SmartSwitch 9000 Local Management User's Guide*.

The 9H423-26 also features front panel LANVIEW™ Diagnostic LEDs to offer at-a-glance status information about each front panel port as well as the operation of the overall module.

Features

Processor

The 9H423-26 module is equipped with an advanced Intel i960 microprocessor. This microprocessor provides a platform for all management functions such as Spanning Tree, RMON, and MIB support, within a scalable RISC-Based architecture.

Fast Packet Switching

The 9H423-26 module incorporates a hardware-based switch design referred to as the SmartSwitch ASIC, a collection of custom ASICs designed specifically for high-speed switching. Because all frame translation, address lookups, and forwarding decisions are performed in hardware, these modules can obtain a throughput performance of greater than 750K pps.

Management

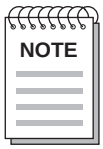
The 9H423-26 features SNMP for local and remote management. Local management is provided through the RS232 COM ports on the SmartSwitch 9000 Environmental Module, using a standard VT220 ^{TM} terminal or emulator. Remote management is possible through Cabletron's SPECTRUM or any SNMP-compliant management tool. Included as management features are the IETF Standard Management Information Base (MIBs) RMON (RFC 1271), IETF MIB II (RFC 1213), IETF Bridge MIB (RFC 1493), and a host of other Cabletron enterprise MIBs. These modules also offer a wide variety of statistical network management information to enhance network planning and troubleshooting. The 9H423-26 provides information for each front panel Ethernet port, including packet counts along with errored frame information such as collisions, CRCs, and Giants, via a variety of industry standard and private MIBS. Industry standard IEEE 802.1d bridging, including Spanning Tree Algorithm, is supported.

Connectivity

The 9H423-26 module has one interface to the INB and 26 front port connections. The INB interface is a fixed connection to INB-B that allows the module to communicate with other SmartSwitch 9000 modules supporting various LAN technologies including, Token Ring, FDDI, Ethernet, WAN, Fast Ethernet and ATM. The module is configured with two RJ21 connectors and two SC fiber connectors. The two RJ21 connectors provide twenty-four 10/100 Mbps Ethernet ports. The two multimode SC connectors provide 100BASE-FL connections, with links up to 2000 meters in length.

Auto-negotiation

The auto-negotiation feature (available only with the 100BASE-T RJ21 ports) allows the module to automatically use the fastest rate supported by the device at the other end (either 10 Mbps or 100 Mbps at either half or full duplex). To negotiate duplex, both the 9H423-26 and the attached device must be configured for auto-negotiation. If only the 9H423-26 is configured for auto-negotiation, the module will set the connection to half duplex at either the 10 Mbps or 100 Mbps rate. This technology is similar to how modems negotiate transmission speed, finding the highest transmission rate possible. Similarly, auto-negotiation determines the highest common speed between two devices and communicates at that speed. If no common speed is detected, the device will be partitioned.



RJ21 connections are capable of auto-negotiation, and can operate at 10 Mbps or 100 Mbps, full or half duplex. Fiber connections can only operate at the 100 Mbps rate, full duplex.

Standard Ethernet/Full Duplex Operation

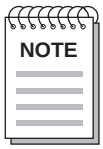
The 9H423-26 module supports 100BASE technology. This allows each port on the module to be configured, through local and or remote management (SNMP), to operate in standard Fast Ethernet mode (simplex) or full duplex mode. Operating in standard Fast Ethernet mode limits bandwidth to 100 Mbps per port, while operating in duplex mode doubles bandwidth from 100 Mbps to 200 Mbps per port.

Management Information Base (MIB) Support

The 9H423-26 module provides MIB support including:

- RMON (RFC 1757)
- IETF MIB II (RFC 1213)
- IETF Bridge MIB (RFC 1493)

and a host of other Cabletron Enterprise MIBs.



For a complete list of supported MIBs, refer to the release notes provided with the 9H423-26.

INB

The 9H423-26 module attaches to INB-B of the SmartSwitch 9000 Backplane. The INB backplane is designed to transport fixed-length data blocks between modules in the SmartSwitch 9000 using an INB Time Division Multiplexing (ITDM) design. The SmartSwitch 9000 INB bus delivers 2.5 Gbps of true data bandwidth with all control and management communication being serviced on the 8-bit out-of-band bus. The time slices of the INB manager operate in all three modes at once, without user intervention.

Arbitration for the backplane is accomplished in the INB Time Division Multiplexing (ITDM) logic. The arbitration is a three-level scheme that ensures that no one can get the backplane for more than one time slice at a time.

The ITDM RAM contains 256 4-bit locations. This RAM is used to hold slot numbers of modules participating in INB backplane arbitration. The arbitration engine accesses this RAM once every time slice to get a slot number. That slot number will be granted access on the next time slice if it is requesting. The arbitration engine is always one time slice ahead, meaning that the value read from the RAM is for the next time slice, not the current time slice.

LANVIEW LEDs

The 9H423-26 module uses LANVIEW – the Cabletron Systems built-in visual diagnostic and status monitoring system. With LANVIEW LEDs, you can quickly identify, at-a-glance, system status as well as the device, port, and physical layer status. Two LEDs indicate the transmission and reception of data from the INB SmartSwitch 9000 backplane connection. Each of the 24 Ethernet front panel ports features two LEDs per port to indicate the port's Administrative status (enabled / disabled), LINK status (Link / Nolink), and Data Activity (receiving and transmitting data).

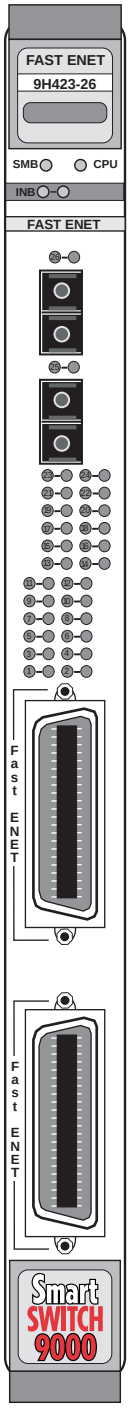


Figure 1-1. The 9H423-26 Module

Related Manuals

The Cabletron Systems manuals listed below should be used to supplement the procedures and technical data contained in this manual.

SmartSwitch 9000 Installation Guide
SmartSwitch 9000 9C300-1 Environmental Module User's Guide
SmartSwitch 9000 9C214-1 AC Power Supply User's Guide
SmartSwitch 9000 Local Management User's Guide
INB Terminator Modules Installation Guide

Getting Help

For additional support related to this device or document, contact the Cabletron Systems Global Call Center:

Phone	(603) 332-9400
Internet mail	support@ctron.com
FTP Login Password	ctron.com (134.141.197.25) *anonymous* *your email address*
BBS Modem setting	(603) 335-3358 8N1: 8 data bits, No parity, 1 stop bit
For additional information about Cabletron Systems or its products, visit the World Wide Web site: **http://www.cabletron.com/** For technical support, select **Service and Support**.	
To send comments or suggestions concerning this document, contact the Cabletron Systems Technical Writing Department via the following email address: **TechWriting@ctron.com** *Make sure to include the document Part Number in the email message.*	

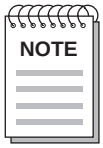
Before calling the Cabletron Systems Global Call Center, have the following information ready:

- Your Cabletron Systems service contract number
- A description of the failure
- A description of any action(s) already taken to resolve the problem (e.g., changing mode switches, rebooting the unit, etc.)
- The serial and revision numbers of all involved Cabletron Systems products in the network
- A description of your network environment (layout, cable type, etc.)
- Network load and frame size at the time of trouble (if known)
- The device history (i.e., have you returned the device before, is this a recurring problem, etc.)
- Any previous Return Material Authorization (RMA) numbers

Chapter 2

Installing the 9H423-26 Module

The 9H423-26 module occupies a single slot in the SmartSwitch 9000 chassis.



The INB Terminator Modules must be installed on the rear of the chassis before powering up this module. Refer to the ***INB Terminator Modules Installation Guide*** *for information and installation procedure.*

Install the modules by following the steps described later in this chapter.

Unpacking the Module

1. Carefully remove the module from the shipping box. (Save the box and packing materials in the event the module must be reshipped.)
2. Remove the module from the plastic bag. Observe all precautions to prevent damage from Electrostatic Discharge (ESD).
3. Carefully examine the module, checking for damage. If any damage exists, DO NOT install the module. Contact Cabletron Systems Global Call Center immediately.

User-Accessible Components

Figure 2-1 shows the various components that can be accessed by users. These consist of an eight-position dip switch (explained in the next section), replaceable PROMs, and sockets for memory and flash upgrades. These can be used for future upgrades. Instructions for installing the components are supplied with the upgrade kits.

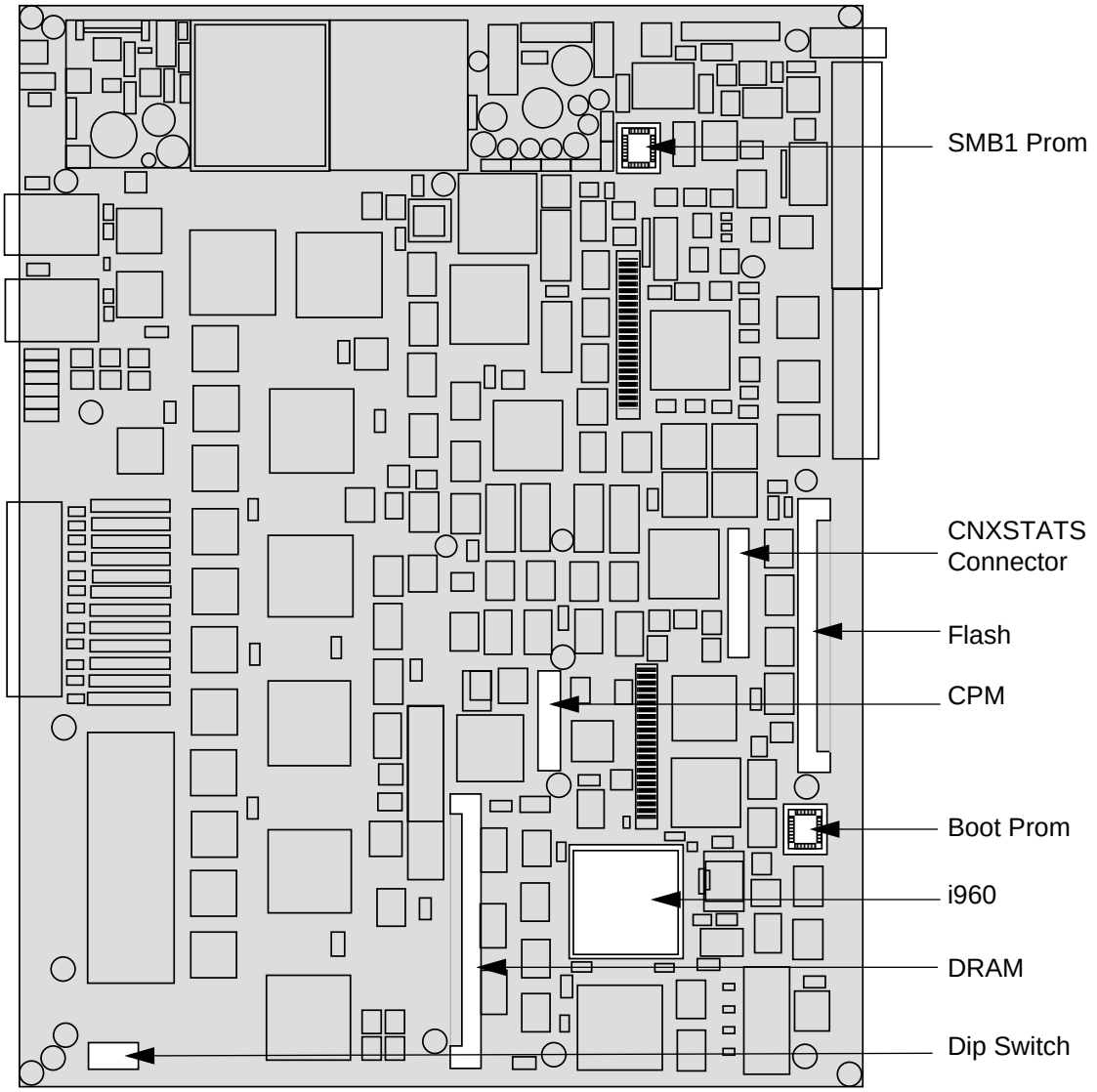


Figure 2-1. User-Accessible Components

Setting the Module DIP Switch

The DIP switch on the 9H423-26 module (Figure 2-1), is an eight-switch DIP located near the left, bottom corner of the module. Each switch is set according to the functions described in Table 2-1. If switch settings are changed, the processor on the module must be reset, using the reset switch or repowering the module, for changes to take effect.

See the **Cautions** at the end of this table.

Table 2-1. Function of DIP Switch

Switch	Function	Description
8	**Clear Password[-1]**	This module stores user-entered passwords in NVRAM (Nonvolatile Random Access Memory). To clear these passwords, toggle this switch and then reset the module's processor. Once the module resets, factory default passwords are placed in NVRAM. You can use these default passwords or, if desired, enter new passwords. To enter new passwords, refer to the Module Local Management User's Guide.
7	**Clear NVRAM[-2]**	This module stores user-entered parameters such as IP addresses, subnet masks, default gateway, default interface, SNMP traps, bridge configurations and module specific configurations in NVRAM. To clear these parameters toggle this switch and then reset the module's processor. Once the module resets, factory default parameters are placed in NVRAM. You can use the default parameters or, if desired, enter new parameters. To enter new parameters, refer to the Module Local Management User's Guide.
6	**Force BOOTP Download**	This module uses BOOTP (Boot Strap Protocol) to download new versions of the image file into Flash Memory. This procedure forces image files to be downloaded from the PC or Workstation, configured to act as the BOOTP server, connected to the EPIM port in the Environmental Module.
5	**Reserved**	For Factory Use Only
4	**Reserved**	For Factory Use Only
3	**Reserved**	For Factory Use Only
2	**Reserved**	For Factory Use Only
1	**Reserved**	For Factory Use Only

[1]***Caution:*** *Do not toggle Switch 8 unless you intend to reset the user-configured passwords to the factory default settings.*

[2]***Caution:*** *Do not toggle Switch 7 unless you intend to reset the user-entered parameters to the factory default settings.*

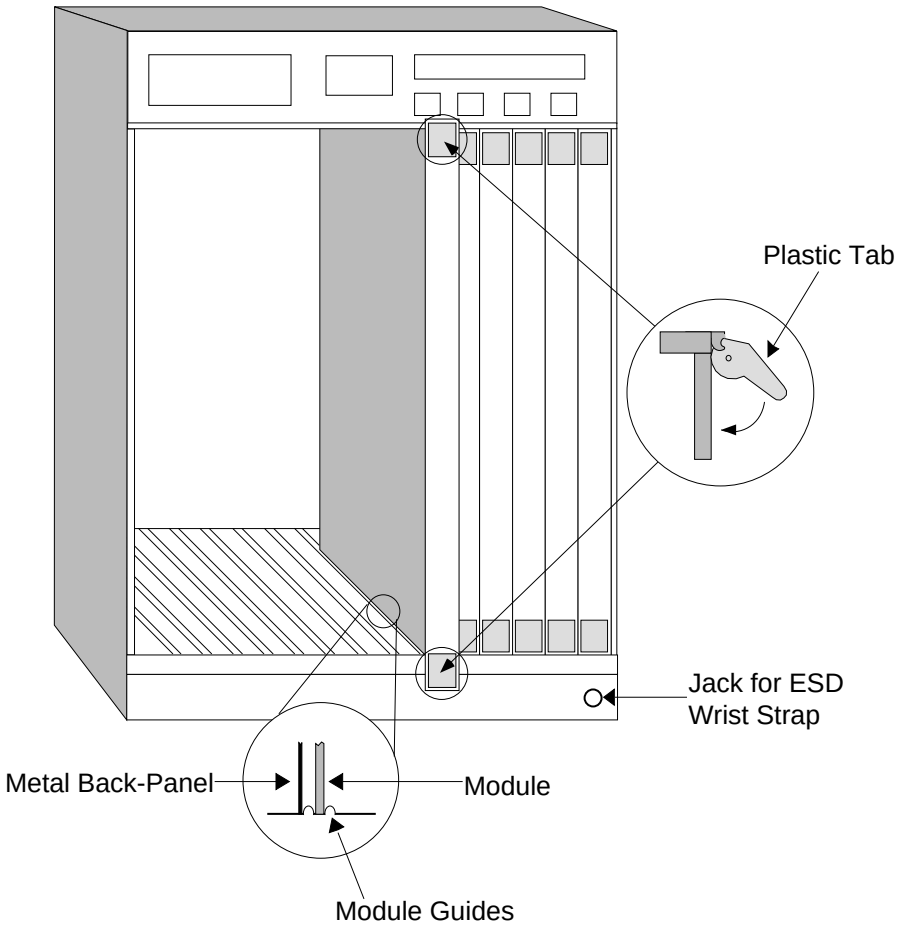
Installing the Module in the SmartSwitch 9000 Chassis

To install the 9H423-26 module in the SmartSwitch 9000 chassis, follow the steps below:

1. Remove the blank panel covering the slot in which the module will be mounted. All other slots must be covered to ensure proper air flow and cooling.

2. Attach one end of the ESD wrist strap (packaged with the SmartSwitch 9000 chassis) to your wrist. Plug the other end into the jack for the ESD wrist strap, located in the lower right corner of the SmartSwitch 9000 chassis shown in Figure 2-2.

3. Slide the module into the slot and lock down both the top and bottom plastic tabs, as shown in Figure 2-2. Take care that the module is between the card guides as shown, it slides in straight, and engages the backplane connectors properly.



Warning:

Ensure that the circuit card is between the card guides. Lock down the top and bottom plastic tabs at the same time, applying even pressure.

Figure 2-2. Installing the Module

The Reset Switch

The Reset switch is located on the front panel, under the top plastic tab as shown in Figure 2-3. It serves three functions: resetting the i960 processor, shutting down the module, or restarting the module.

- To reset the i960 processor, press the reset switch twice within three seconds.
- To shut down the module, press and hold the reset switch down for three or more seconds.
- To restart the module after it has been shut down, press and release the Reset Switch.

For security, SNMP management can be used to disable the functions of this switch.

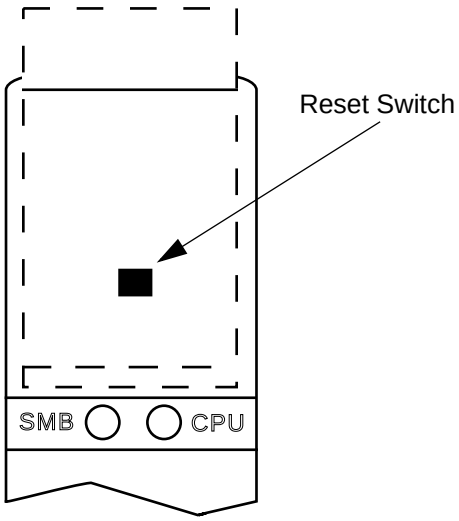


Figure 2-3. The Reset Switch

Chapter 3

Operation

The 9H423-26 module is a twenty-seven port device. Two front panel RJ21 connectors support twenty-four 100BASE-T ports, along with two SC fiber connectors that support two 100BASE-FL ports. Each of these twenty-six ports is a separate collision domain, while the 27th port connects to INB-B.

As shown in Figure 3-1, Fast Ethernet Network Interface Blocks (FENIBs) convert data packets received from any of the 100BASE ports into a canonical frame format before forwarding to the SmartSwitch ASIC, while the Internal Network Bus Network Interface Block (INB NIB) converts data packets received from the INB into a canonical format before forwarding to the SmartSwitch ASIC.

All data packets destined for a front panel port, the INB, or the i960 are converted into the canonical format before forwarding to the SmartSwitch ASIC. Network Interface Blocks (NIBs) check for valid data packets entering the system. If an errored data packet is found, the SmartSwitch ASIC flags the error and does not forward the errored data packet to any outbound ports. Once in this common format, the SmartSwitch ASIC decides from header information the port destination of data packets. Data packets are then converted from the canonical format to the proper format for the interface destination whether it is a front panel port, or connection to the INB.

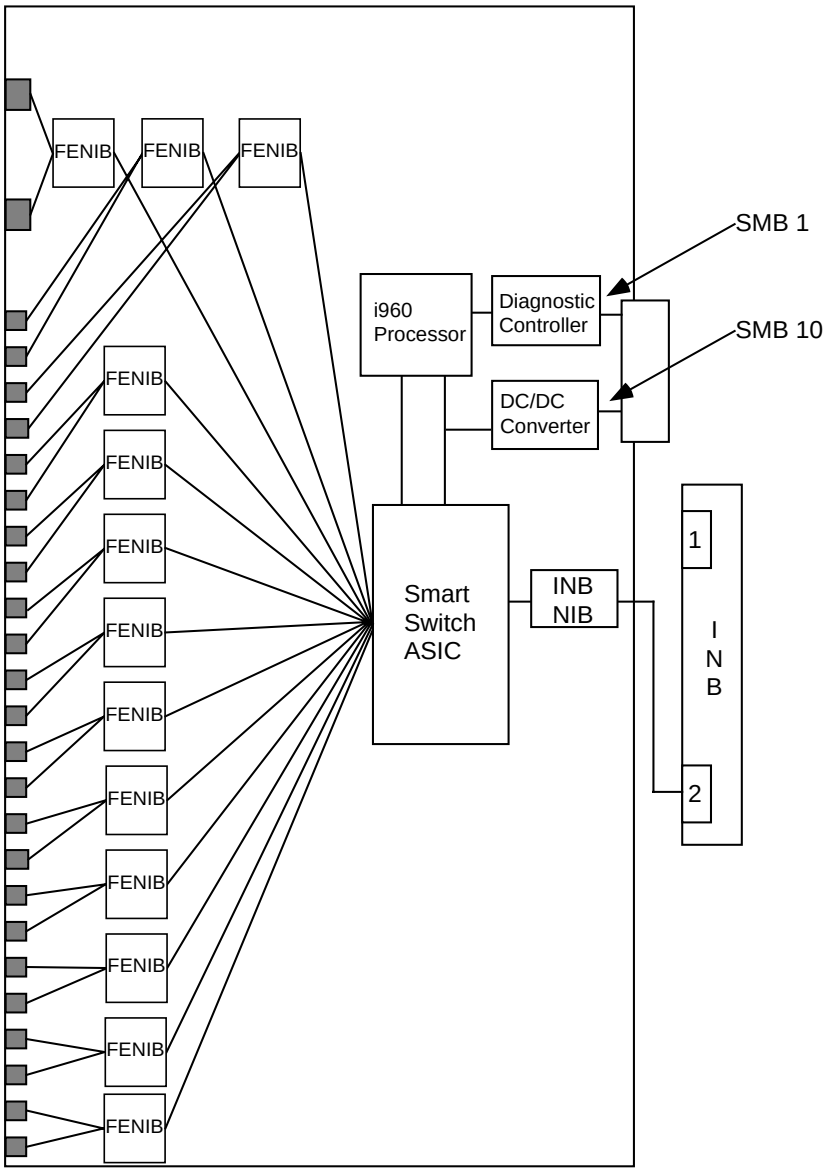


Figure 3-1. Packet Flow for the 9H423-26

FENIB

The Fast Ethernet Network Interface Block (FENIB) converts Fast Ethernet data packets received through front-panel ports into a common canonical format that allows the SmartSwitch ASIC Engine to determine the proper destination port. The FENIB also converts data packets from the common canonical format back to Fast Ethernet data packets for transmission out front panel ports.

SmartSwitch ASIC

The SmartSwitch ASIC is a hardware-based switch design that is the key building block of the SmartSwitch 9000 hub. The SmartSwitch ASIC makes all filtering / forwarding decisions in custom hardware as opposed to software as in traditional bridges. This custom hardware enables the SmartSwitch ASIC to process over 750K frames per second. The SmartSwitch ASIC is designed to support up to 64 ports, shared between the host processor, the INB backplane, and LAN / WAN interfaces on the front panel of SmartSwitch 9000 modules. The SmartSwitch ASIC can operate in two modes: as a traditional switch or as a SecureFast switch.

Traditional Switch

When operating as a traditional switch, the SmartSwitch ASIC makes filtering / forwarding decisions based on Destination Address (DA), with standard IEEE 802.1d learning.

VLAN

Modules within an MMAC chassis utilize connection-oriented SecureFast switches to create Virtual LANs, or VLANs.

A VLAN is a local area network of endpoints having full connectivity (sharing broadcast, multicast, and unicast packets) independent of any particular physical or geographical location. In other words, endpoints that share a virtual LAN appear to be on a single LAN segment regardless of their actual location. Changes to VLANs (e.g., moving nodes), are accomplished via software, reducing network management time and expense.

VLANs extend direct communication between users beyond the constraints of a physical LAN segment by allowing the establishment of VLANs that encompass users on multiple physical LAN segments. This permits endpoints to be administratively grouped. For example, in Figure 3-2, the users on LANs A and B belong to the Finance group; however, they are physically removed from each other and, as such, cannot communicate directly. The VLAN solution places both LAN segments on the same VLAN; all endpoints appear and act as if they are on the same physical LAN.

Most VLAN implementations require a router for Inter-VLAN communication; Cabletron's SecureFast VLAN operational model does not. Inter-VLAN communication is accomplished via multi-layer switches or optional traditional router.

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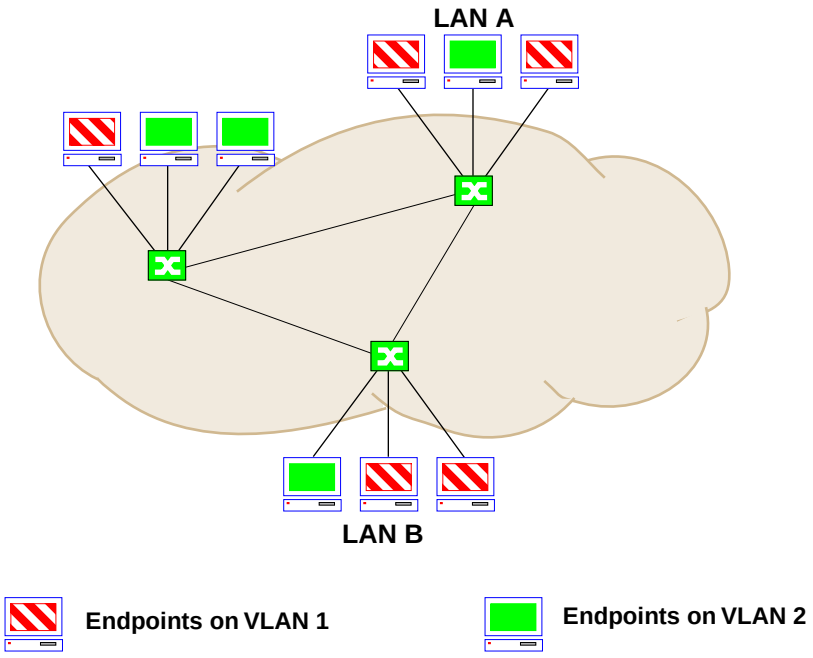

Figure 3-2. VLAN-based Network

VLAN Domains

VLAN domains consist of groups of interconnected VLAN switches separated by routing devices. Figure 3-3 shows such an arrangement. Each group of switches constitutes a VLAN domain.

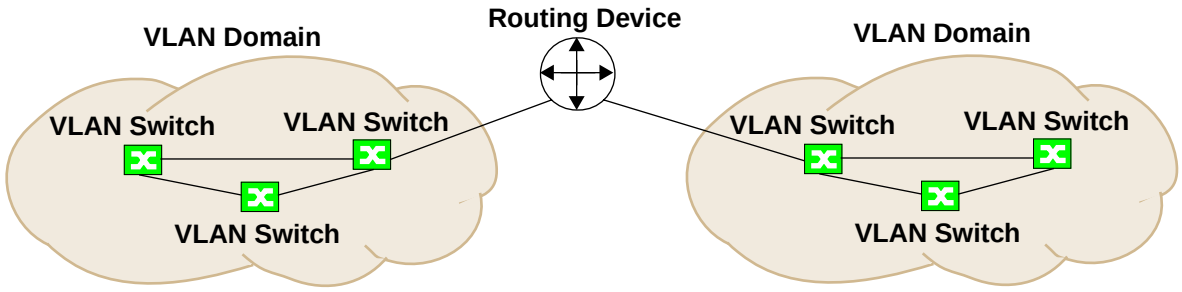

Figure 3-3. VLAN Domains

Fully Meshed VLAN Domains

The switches shown in figure 3-3 above are said to be fully meshed. The term “fully meshed” is often used when describing the connections between switches in a domain. Fully meshed implies that there are links between all switches to every other switch. A fully-meshed topology provides high reliability and low delays between endpoints. Figure 3-4 shows a VLAN domain consisting of four fully-meshed VLAN switches.

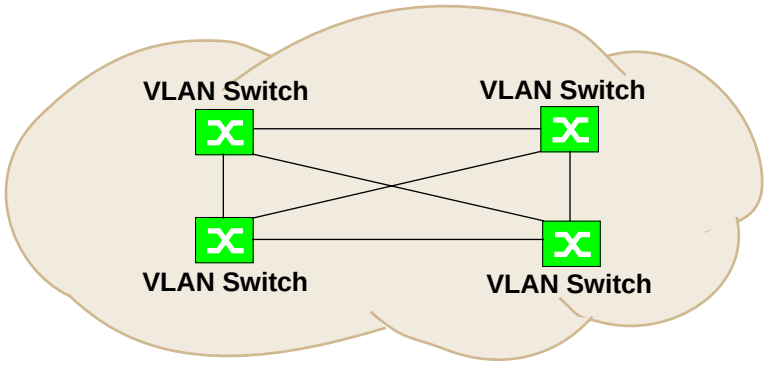

Figure 3-4. Fully Meshed VLAN Domain

SecureFast VLAN Switches

SecureFast VLAN (SFVLAN) switches are connection-oriented internetworking devices. These devices use source address / destination address (SA / DA) pairs along with embedded layer 3 virtual routing services to provide address resolution and call processing. In a connection-oriented network, path determination is accomplished through signaling performed at call set-up time. Once a call is programmed, no additional software intervention is required until the call is completed. This type of call management operates much like a telephone network. The circuit is set up, data is transferred, and the circuit is torn down.

Switches switch packets at the MAC layer and allow connectivity of endpoints via Access Ports based on VLAN mappings. The first packet is routed, the remaining packets are then switched along the same path. Each VLAN switch maintains a Local Directory of endpoint MAC and network addresses found on each switch port. The aggregation of each VLAN switch’s Local Directory forms a complete view of an entire VLAN domain. This information is used by the VLAN Manager for assignment and verification of VLANs.

i960 Core

The i960 core provides the SNMP protocol stacks, to support industry-standard MIBs. Additionally, Cabletron enterprise extension MIBs are supported for each media type. Advanced management services, such as the Distributed LAN Monitor, telnet and network address to MAC address mapping, are also provided by the i960 core.

The Host engine sends and receives packets via the CPU's SmartSwitch ASIC Interface. This allows the bridge to perform spanning tree protocol and other bridging functions. The SMB Interfaces provide communication to the Host Engine for management functions.

INB NIB

Each module that attaches to the Internal Network Bus (INB) has an INB Network Interface Block (NIB). The INB NIB converts canonical frames to fixed-length data blocks for transmission onto the INB. For data blocks received from the INB, the INB NIB reassembles the data blocks received from the INB back into canonical frames for transmission to the SmartSwitch ASIC then from the SmartSwitch ASIC to the front panel ports.

System Management Buses

There are two management channels within the SmartSwitch 9000 system: the SMB-1 and the SMB-10. These buses provide side-band management and inter-module management communication.

SMB-1 Bus

The SMB-1 is a 1 Mbps management bus located within the SmartSwitch 9000. This bus is utilized by all diagnostic controllers in the system including connectivity modules, power supply modules and the environmental module. The SMB-1 transports inter-chassis information between system components, such as power and environmental information, as well as diagnostic messages. Periodic loop-back tests are performed by all modules that share this bus to ensure the validity of SMB-1. In the event a failure is detected on SMB-1, the SMB-10 may be used as an alternate communication channel.

SMB-10 Bus

The SMB-10 is a 10 Mbps management bus located within the SmartSwitch 9000. This bus is used for inter-chassis communication of modules as well as serving as a side-band management channel into the SmartSwitch 9000.

The SMB-10 is externalized from the chassis via an optional Ethernet Port Interface Module (EPIM) located on the front of the Environmental Module. Through an EPIM connection, full-SNMP management of the SmartSwitch 9000 is available side-band from user data. Modules that share the SMB-10 bus periodically send out loop-back packets to ensure the validity of SMB-10. If a fault is detected on the SMB-10, the SMB-1 can be used as an alternate communication channel by the modules.

System Diagnostic Controller

This diagnostic controller is composed of a Z-80 microprocessor and its supporting logic. The diagnostic controller is designed to control the power-up sequencing of modules, monitor the 9H423-26 module input and output power parameters, keep watch over the main host processor, monitor the temperature, and control the SMB LANVIEW diagnostic LEDs. Although the system diagnostic controller and the main host processor can operate independently of each other if needed, they exchange information about each other's status and overall module condition. The information gathered by the diagnostic controller is available to the network manager via local / remote management and the LCD located on the environment module. The 9H423-26 is designed to continue functioning in the event of a diagnostic controller fault.

DC/DC Converter

The DC / DC converter converts the 48 VDC on the system power bus to the necessary operating voltages for its host network services module. The diagnostic controller monitors and controls the operation of the DC / DC converter.

INB Interface

The INB Backplane is designed to transport fixed-length data blocks between modules in the SmartSwitch 9000 using an INB Time Division Multiplexing (ITDM) design. The SmartSwitch 9000 INB bus delivers 2.5 Gbps of true data bandwidth with all control and management communication being serviced on the 8-bit out-of-band bus. The time slices of the INB manager operate in all three modes at once, without user intervention.

Arbitration for the backplane is accomplished in the INB Time Division Multiplexing (ITDM) logic. The arbitration is a three-level scheme that ensures that no one can get the backplane for more than one time slice at a time.

The ITDM RAM contains 256 4-bit locations. This RAM is used to hold slot numbers of modules participating in INB backplane arbitration. The arbitration engine accesses this RAM once every time slice to get a slot number. That slot number will be granted access on the next time slice if it is requesting. The arbitration engine is always one time slice ahead, meaning that the value read from the RAM is for the next time slice, not the current time slice.

The RAM is programmed on system power-up or whenever a module is inserted / removed from the SmartSwitch 9000 chassis. There is a module discovery program running that will detect these events. The amount of RAM to be used and the position of the slot numbers in the RAM is determined by a higher level system management program.

ITDM Arbitration levels

The three levels of arbitration guarantee that a module will get its allocated bandwidth plus some more depending on what levels of arbitration it is participating in.

ITDM RAM Allocation (Level 1)

This level guarantees access to the backplane. When a module requests access to the backplane, it will get access to it when its slot number is placed onto the bus. This will ensure predicted or predetermined access to the backplane.

Round Robin Arbitration (Level 2)

This level makes use of idle time slices. There is a token passed on every time slice to modules participating in this level of arbitration. Only one module has the token at any one time slice. If the module assigned to the next time slice is not requesting then the module with the token will be granted access if it is requesting. The token is passed to the next highest slot number participating each time slice.

Lowest Slot Number (Level 3)

This level is only used if the other two levels fail in granting access to the backplane. If the owner of the token is not requesting, then the lowest slot number requesting will be granted access. This ensures that a time slice will not be idle if there are modules requesting access.

Monarch/Slave SmartSwitch 9000 Modules

All modules in an SmartSwitch 9000 chassis that transfer packets across the INB backplane have identical INB interfaces. However, one of them has to be selected to perform the backplane arbitration. The lowest slot number module will automatically be selected as the arbitrator. This module will be called the Monarch and others will be Slaves to that module. If the Monarch module is removed from the chassis, a re-election occurs and the module with the lowest slot number is elected Monarch.

Cabletron's INB Bandwidth Arbitrator, the third method permits the lowest slot number to use any bandwidth not used by the previous two methods.

Chapter 4

LANVIEW LEDs

The front panel LANVIEW LEDs indicate the status of the module and may be used as an aid in troubleshooting. Shown in Figure 4-1 are the LANVIEW LEDs of the 9E423-26 module.

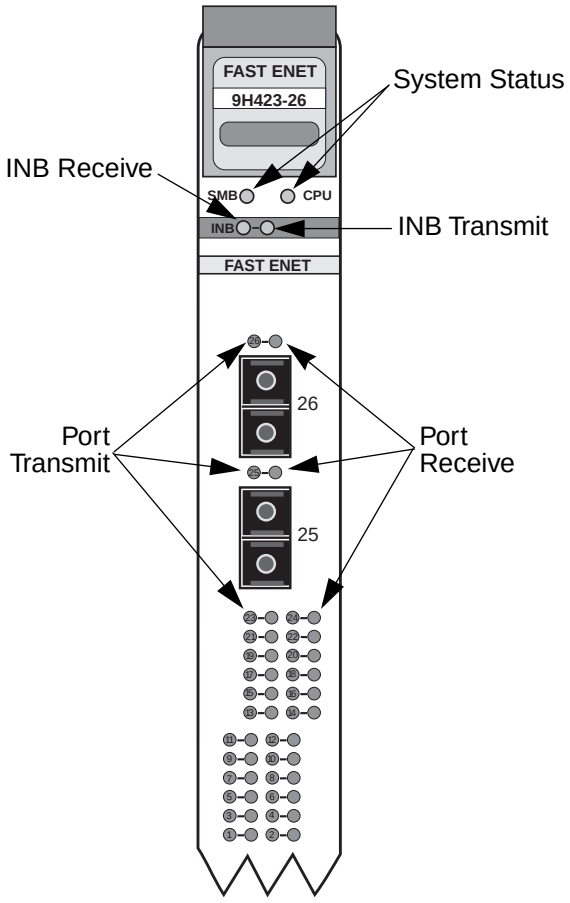

Figure 4-1. The LANVIEW LEDs

The functions of the two System Status LEDs, System Management Bus (SMB) and CPU (Central Processing Unit), are listed in Table 4-1.

Table 4-1. System Status (SMB and CPU) LEDs

LED Color	State	Description
Green	Functional	Fully operational
Yellow	Testing	Power up testing
Yellow (Blinking)	Crippled	Not fully operational (i.e. one port may be bad)
Yellow / Green	Booting	Module is performing its boot process
Red	Reset	Module is resetting
Red (Blinking)	Failed	Fatal error
Off	Power off	Module powered off

The functions of the INB Receive LED are listed in Table 4-2.

Table 4-2. INB Receive LED

LED Color	State
Green	Link, no activity, port enabled
Green (Blinking)	Link, port disabled
Yellow (Flashing)	Link, activity, port enabled (Flashing to steady on indicates rate.)
Red	INB fault, (not synchronized with the Monarch)
Off	No link, no activity (port enabled)

The functions of the INB Transmit LED are listed in Table 4-3.

Table 4-3. INB Transmit LED

LED Color	State
Green (Flashing)	Activity, port enabled (Flashing to steady on indicates rate.)
Yellow (Blinking)	Port in standby state
Red	INB fault
Off	Link (port disabled)

The functions of the Port Receive LEDs are listed in Table 4-4.

Table 4-4. Port Receive LEDs

LED Color	State
Green	Link, no activity port enabled
Green (Blinking)	Link, port disabled
Yellow (Flashing)	Link, activity, port enabled (flashing to steady on indicates rate)
Red	Fault
Off	No link, (port disabled)

The functions of the Port Transmit LEDs are listed in Table 4-5.

Table 4-5. Port Transmit LEDs

LED Color	State
Green (Flashing)	Data activity (flashing to steady on indicates rate)
Yellow (Blinking)	Port in standby state
Red (Flashing)	Collision (with collision rate)
Red	Fault
Off	No activity, port can be disabled or enabled

Chapter 5

Specifications

Technical Specifications

CPU

Intel i960 RISC based microprocessor

Memory

4 Mb	Local RAM (expandable to 32 MB)
4 Mb	Flash Memory (expandable to 32 MB)
2 Mb	Packet RAM
16 Mb	DRAM (expandable to 48 MB)

Standards

IEEE 802.1D

IEEE 802.3U 100BASE-T

IEEE 802.3U 100BASE-FX

Network Interfaces

2 fixed RJ21 connectors

2 fixed multi-mode fiber SC connectors

Safety

It is the responsibility of the person who sells the system to which the module will be a part to ensure that the total system meets allowed limits of conducted and radiated emissions.

This equipment meets the safety requirements of

UL 1950
CSA C22.2 No. 950
EN 60950
IEC 950

The EMI Requirements of

- FCC Part 15 Class A
- EN 55022 Class A
- VCCI Class I

The EMC requirements of

- EN 50082-1
- IEC 801-2 ESD
- IEC 801-3 Radiated susceptibility
- IEC 801-4 EFT

Service

MTBF (MHBK-217E)	>200,000 hrs.
MTTR	<0.5 hr.

Physical

Dimensions

35.0 D x 44.0 H x 6.0 W centimeters
(13.8 D x 17.4 H x 1.2 W inches)

Weight

Unit:	1.360.7 gr. (3 lbs.)
Shipping:	1.814.4 gr. (4 lbs.)

Environment

Operating Temperature:	5° to 40° C (41° to 104° F)
Storage Temperature:	-30° to 90° C (-22° to 164° F)
Relative Humidity	5% to 95% (non-condensing)

Appendix A

9H423-26 Cabling Requirements

To achieve the highest possible performance from your 9H423-26, proper cabling assemblies and connector hardware for a high speed Fast Ethernet connection are required. This appendix reviews the 9H423-26 connector types and explains the proper mating cabling assemblies.

Overview

The 9H423-26 supports data rates up to 100 Mbps, requiring cables and connecting hardware that can physically transmit signals at that rate without degrading transmission performance. Although the 9H423-26 may run at 10 Mbps when linked to an Ethernet network, it is required to maintain the capability to connect and perform at the Fast Ethernet 100 Mbps rate. It is therefore necessary to have **Category 5 cables and connectors** for the 9H423-26 to handle signal transmission for both 10 Mbps and 100 Mbps.

The 9H423-26 front panel (See Figure 1-1 in Chapter 1) is equipped with two multimode fiber SC connectors, for 100BASE-FX transmission, located at the top half of the board. The bottom half carries two Category 5, 25-pair, 50-pin “Telco” connectors (RJ21) for 10/100BASE-TX transmission. Port numbering begins from the bottom with ports 1 thru 12 on the lowermost RJ21, ports 13 thru 24 on the uppermost RJ21, and ports 25 and 26 on the top located fiber SC connectors.

Fast Ethernet Standard Requirements

100BASE-TX

The IEEE 802.3u (Fast Ethernet specification) specifies for 100BASE-TX to use either two pair 100 ohm Category 5 unshielded twisted pair (UTP) cable or 2 pair 150 ohm shielded twisted pair (STP) cable. **This module utilizes Category 5 100 ohm UTP Cabling systems**. Two copper wires, each encased in its own color-coded insulation, are twisted together to form a 'twisted pair'. Numerous twisted pairs are then packaged together to form twisted pair cables in an outer sheath. Twists in the cable block interference between pairs by using balancing and filtering techniques through media filters and baluns. Noise is induced equally on two conductors that cancels out at the receiver. Because of this and the fact that UTP cabling is lightweight, thin, inexpensive, and versatile, UTP cabling tends to be the cable of choice.

The typical single-UTP cable contains four pairs of wires connected to a RJ45 (Figure A-1). Two pairs of conductors, one pair of wires for transmit and one pair of wires for receive, are needed for 100BASE-TX transmission. For 100BASE-TX, the remaining two pairs are unused. (10BASE-T4 and 100BASE-T4 utilize all four pairs.) Refer to Table A-1 and Figure A-2.

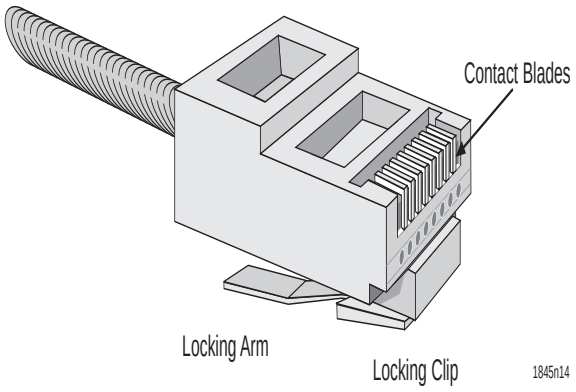

Figure A-1. RJ45 Connector

Table A-1. RJ45 PINOUT

RJ45 Pin #	Wire Color Code	Pair	EIA/TIA 568A Wiring
5	White / Blue	Pair 1	Not used
4	Blue		
3	White / Orange	Pair 2	RX+
6	Orange		RX-
1	White / Green	Pair 3	TX+
2	Green		TX-
7	White / Brown	Pair 4	Not used
8	Brown		

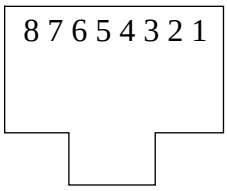

Figure A-2. RJ45 Plug Pinout

On the 9H423-26, the connecting hardware is **not** an eight-wire RJ45, but a 50-wire, 25-pair RJ21 (Figure A-3).

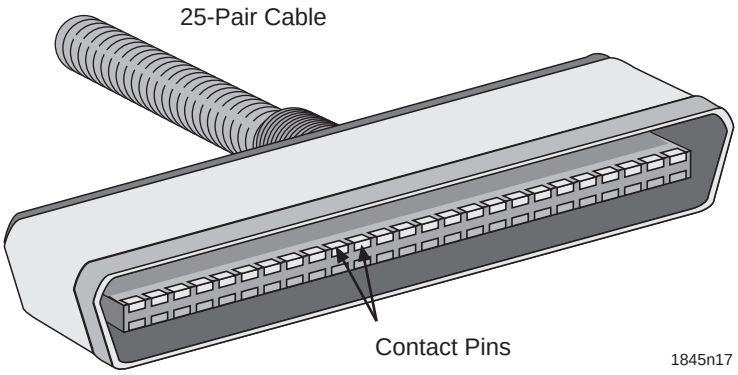

Figure A-3. RJ21 Connector

The RJ21 connector is a D-shaped metal housing that is wired and crimped to a 25-pair UTP cable (Figure A-4).

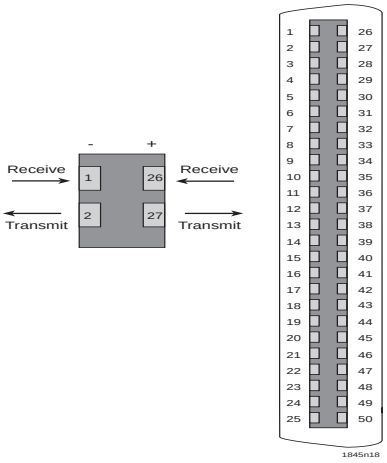

Figure A-4. RJ21 Pinout

The RJ21 connector has one pair that is unconnected: pair 25, which corresponds to pins 25 and 50 on the RJ21. It is left floating. This “Telco” connector utilizes the standard EIA / TIA 568A wiring scheme. Refer to Table A-2.

Table A-2. RJ21 PINOUT

RJ21 Pin #	Wire Color Code	Pair	Signal	Port
26	**White** / Blue	1	RX+	1
1	**Blue** / White		RX-	
27	**White** / Orange	2	TX+	
2	**Orange** / White		TX-	
28	**White** / Green	3	RX+	2
3	**Green** / White		RX-	
29	**White** / Brown	4	TX+	
4	**Brown** / White		TX-	
30	**White** / Slate	5	RX+	3
5	**Slate** / White		RX-	
31	**Red** / Blue	6	TX+	
6	**Blue** / Red		TX-	
32	**Red** / Orange	7	RX+	4
7	**Orange** / Red		RX-	
33	**Red** / Green	8	TX+	
8	**Green** / Red		TX-	
34	**Red** / Brown	9	RX+	5
9	**Brown** / Red		RX-	
35	**Red** / Slate	10	TX+	
10	**Slate** / Red		TX-	
36	**Black** / Blue	11	RX+	6
11	**Blue** / Black		RX-	
37	**Black** / Orange	12	TX+	
12	**Orange** / Black		TX-	

Table A-2. RJ21 PINOUT (continued)

RJ21 Pin #	Wire Color Code	Pair	Signal	Port
38	**Black** / Green	13	RX+	7
13	**Green** / Black		RX-	
39	**Black** / Brown	14	TX+	
14	**Brown** / Black		TX-	
40	**Black** / Slate	15	RX+	8
15	**Slate** / Black		RX-	
41	**Yellow** / Blue	16	TX+	
16	**Blue** / Yellow		TX-	
42	**Yellow** / Orange	17	RX+	9
17	**Orange** / Yellow		RX-	
43	**Yellow** / Green	18	TX+	
18	**Green** / Yellow		TX-	
44	**Yellow** / Brown	19	RX+	10
19	**Brown** / Yellow		RX-	
45	**Yellow** / Slate	20	TX+	
20	**Slate** / Yellow		TX-	
46	**Violet** / Blue	21	RX+	11
21	**Blue** / Violet		RX-	
47	**Violet** / Orange	22	TX+	
22	**Orange** / Violet		TX-	
48	**Violet** / Green	23	RX+	12
23	**Green** / Violet		RX-	
49	**Violet** / Brown	24	TX+	
24	**Brown** / Violet		TX-	
50	**Violet** / Slate	25	Unused Pair left floating	
25	**Slate** / Violet			

NOTE

The colors in bold designate the primary color of the wire. For example, pin 26 connects to a wire that is primarily white with blue stripes and pin 1's wire is underlying blue with white stripes. However, because Category 5 has more "twists" than Category 3, vendors might manufacture the twisted pairs with the primary colors only. Therefore pair one will have one white wire, pin 26, twisted with one blue wire, pin 1.

100BASE-FX

On the fiber end, Clause 26 of the IEEE 802.3 defines 1300 nm operation over two strands of 62.5 / 125 µm graded index multimode fiber. FX also permits three types of fiber optic connectors: ST, FDDI MIC, and SC. The duplex SC connector (Figure A-5) houses a transmit and receive fiber in a shared plastic housing. It is important that the transmit (TX) and receive (RX) fibers are clearly labeled.

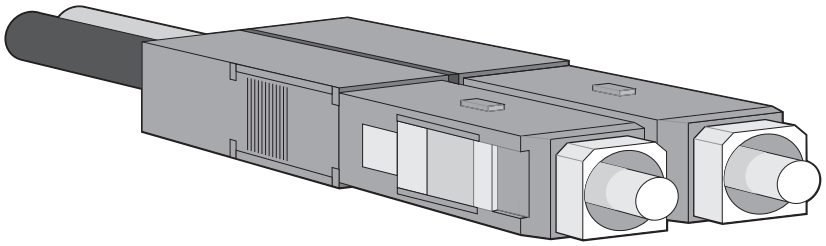

Figure A-5. Fiber SC Connector

Why is CAT 5 Cable Necessary for 100BASE-TX?

Since the 9H423-26's 100BASE-TX RJ21s will mainly be used in 'Horizontal'-type cabling, the remainder of this appendix will discuss this cabling application.

NOTE

Horizontal Cabling refers to the segment of cabling that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications closet. Horizontal Cabling includes the horizontal cabling, telecommunications outlet, cable terminations and cross-connections. See TIA/EIA 568A, Commercial Building Telecommunications Cabling Standard for further information.

Per TIA / EIA 568A, 100 Ω UTP cables and connecting hardware are rated into five classifications: Category 1 through Category 5, based on transmission characteristics and performance requirements. Refer to Table A-3.

Table A-3. 100 Ω UTP Cable Categories

Category (CAT)	Transmission Characteristics specified up to *x* MHz
CAT 1	Not rated
CAT 2	1 MHz
CAT 3	16 MHz
CAT 4	20 MHz
CAT 5	100 MHz

Physical differences between the various classifications of cable attribute to better performance. These include the actual conductor materials and twists per the pairs.

To be qualified and verified as Category 5, there are certain transmission parameters and restrictions placed upon the cable and connecting hardware that are listed below:

- DC Resistance - The resistance of any conductor cannot exceed 9.38 Ω per 100 meters at 20˚C.
- DC Resistance Unbalance - Between the two conductors in a pair, the resistance unbalance cannot surpass 5%.
- Mutual Capacitance - Voltages in one conductor create electric fields in the other. They interact electrically. Thus consequently between the pairs, there is mutual capacitance.

  The mutual capacitance of any pair at 1 kHz and 20˚ C should not exceed 5.6 nF per 100 m for Category 4 and Category 5 cables. Category 3 cables should not exceed 6.6 nF / 100 m.
- Capacitance Unbalance - The capacitance unbalance to ground of any pair should not exceed 330 pF per 100 m at 1kHz.
- Characteristic Impedance - All categories of horizontal UTP cables specified herein have a characteristic impedance of 100 Ω + / - 15%.

The measured input impedance will vary as a function of frequency due to the structural non-uniformities of the cable. The fluctuations superimposed on a curve asymptotically approaches a fixed value, namely the characteristic impedance. The fluctuations in input impedance are related to the Structural

Return Loss (SRL). Refer to Table A-4. To be labeled as Category 5, the following SRL values must be satisfied.

Table A-4. UTP Cable SRL

Freq. f (MHz)	CAT 3 (dB)	CAT 4 (dB)	CAT 5 (dB)
1-10	12	21	23
10-16	$12\log(f/10)$	$21\text{-}10\log(f/10)$	23
16-20	-	$21\text{-}10\log(f/10)$	23
20-100	-	-	$23\text{-}10\log(f/20)$

- Attenuation - Attenuation refers to the amount of signal level degradation through a medium. This can be caused from impurities in the cable, and therefore the signal will not propagate as far. The following table lists the maximum attenuation (dB) per cable pair at 20° C. Refer to Table A-5.

Table A-5. Cable Attenuation per 100 m

Freq (MHz)	CAT 3 (dB)	CAT 4 (dB)	CAT 5 (dB)
0.064	0.9	0.8	0.8
0.256	1.3	1.1	1.1
0.512	1.8	1.5	1.5
0.772	2.2	1.9	1.8
1	2.6	2.2	2.0
4	5.6	4.3	4.1
8	8.5	6.2	5.8
10	9.7	6.9	6.5
16	13.1	8.9	8.2
20	-	10.0	9.3
25	-	-	10.4
31.25	-	-	11.7
62.5	-	-	17.0
100	-	-	22.0

- Near End Crosstalk (NEXT) Loss - The NEXT cites noise and interference within a pair, or more, of conductors where one conductor induces crosstalk on the other.

  The Near End refers to coupling that takes place when the transmit signal entering the link couples back to the receive conductor pair a that same end of the link; in other words, the near-transmitted signal is picked up by the near-receive pair. Refer to Table A-6.

  NEXT loss decreases as the frequency increases according to the following formula:

  $NEXT(f) \geq NEXT(0.772) - 15\log(f/0.772)$

Table A-6. NEXT Loss (Worst Pair Combination) for 100 m

Freq (MHz)	CAT 3 (dB)	CAT 4 (dB)	CAT 5 (dB)
0.150	53	68	74
0.772	43	58	64
1	41	56	62
4	32	47	53
8	27	42	48
10	26	41	47
16	23	38	44
20	-	36	42
25	-	-	41
31.25	-	-	39
62.5	-	-	35
100.0	-	-	32

- Propagation Delay - Electrical signals in conducting wires travel at a speed dependent on the surrounding medium. This is called propagation delay. For Horizontal UTP cable, the propagation delay for any pair at 10 MHz should not exceed 5.7ns / m.

Why are CAT 5 Connectors Necessary for 100BASE-TX?

Similar to the UTP cable itself, the connector hardware plays an important role in the overall performance of the assembly. If an electrical signal travels through a Category 5 cable with little attenuation and then meets an inferior connector, the signal will presently be degraded due to the connector. It is crucial that the mating connector hardware be of the same or higher category classification. In other words, a Category 5 Cable should link with a Category 5 connector for 100 Mbps rates. Thus consequently, certain restrictions and limits are placed upon the connecting hardware and its installation as well to assure minimal effects on cable performance, as listed below:

- Attenuation - Attenuation here refers to the signal power loss due to the connecting hardware. Refer to Table A-7.

Table A-7. Connecting Hardware Attenuation for 100Ω UTP Cable

Freq (MHz)	CAT 3 (dB)	CAT 4 (dB)	CAT 5 (dB)
1	0.4	0.1	0.1
4	0.4	0.1	0.1
8	0.4	0.1	0.1
10	0.4	0.1	0.1
16	0.4	0.2	0.2
20	-	0.2	0.2
25	-	-	0.2
31.25	-	-	0.2
62.5	-	-	0.3
100	-	-	0.4

- Near End Crosstalk (NEXT) Loss - The NEXT applies to signal coupling from one pair of metal pins in a connector to another. It is measured with short lengths of 100Ω twisted pair test leads terminated to the connector under test. Refer to Table A-8.

Table A-8. NEXT Loss (Worst Pair Combination) for 100 m

Freq (MHz)	CAT 3 (dB)	CAT 4 (dB)	CAT 5 (dB)
1	58	65	65
4	46	58	65
8	40	52	62
10	38	50	60
16	34	46	56
20	-	44	54
25	-	-	52
31.25	-	-	50
62.5	-	-	44
100.0	-	-	40

- Return Loss - Return Loss is the measure of the degree of impedance matching between cable and connector. A balanced input signal is applied to a connector pair and the reflected signal is measured. (Reflections occur with mismatched impedances.)

  Return Loss requirements are not specified for Category 3 connectors because they are not considered to have a significant effect on the link. Refer to Table A-9.

Table A-9. Return Loss

	1 to 20 MHz	20 to 100 MHz
CAT 4	> 23 dB	N / A
CAT 5	> 23 dB	> 14 dB

- DC Resistance - The DC resistance between the input and output connections of the connecting hardware for 100Ω cabling shall not exceed 0.3Ω. The DC resistance is measured to determine the connector's ability to transmit direct current and low frequency signals.

  See TIA / EIA 568A normative Annex A and Annex B for the reliability and transmission testing of Connecting Hardware for 100Ω UTP cabling.

Fiber Optic Cabling

As mentioned previously, the 9H423-26 utilizes 1300 nm, 62.5 / 125 µm fiber. Because it will be primarily used in a 'backbone cabling' configuration, the following optical fiber specifications will be stated per this case. (If implementing Horizontal type fiber connections, see TIA / EIA 568A, section 12.2.)

The fiber will be multimode graded-index, 62.5 / 125 µm core / cladding diameter. The following transmission characteristics should be followed as well. Refer to Table A-10.

Table A-10. Backbone 62.5/125 µm Transmission Performance

Wavelength (nm)	Max. Attenuation (dB/km)	Minimum Transmission Capacity (MHz-km)
850	3.75	160
1300	1.5	500